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## EUROPEAN PATENT APPLICATION

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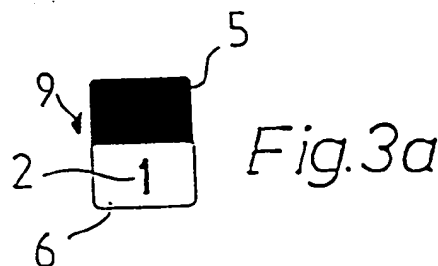
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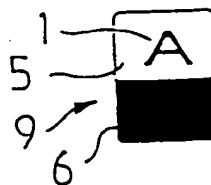
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(54) **Illuminated pushbutton keyboard.**

(57) An illuminated keyboard in which the keys (9) are operable in at least two different modes. Each key (9) is provided with symbols or areas of colour which denote the different modes. The symbols or areas (1,2,5,6) are selectively illuminated depending upon which mode is selected. Thus, in one mode, one area (6) of the keys (9) will be illuminated, while in another mode, another area (5) of the keys (9) will be illuminated. Thus, only the symbols or areas of colour on denoting a selected mode are differentially visibly distinguishable by the user in any selected mode, assisting the user to press the correct key.



*Fig. 3a*



*Fig. 3b*

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The invention concerns an internally illuminated pushbutton keyboard, comprising an individual pushbutton or an array of several pushbuttons in which each pushbutton can be operable to select at least two different functions by pressing the pushbutton and in which the alternative pushbutton functions are indicated on the pushbutton or adjacent thereto, distinguished from one another, and are selectable by means of a separate function key, or as a result of a logical operation using the pushbutton keyboard, such that the mode of operation of the pushbutton or of the entire pushbutton array switches from one mode to another. The invention concerns preferably an illuminated pushbutton keyboard for radio telephones or the like, in which one mode of operation conventionally refers to the keying in of numbers and other functions, and the other to the keying in of letters.

It is highly traditional in the art, for example both in radio telephones, pocket calculators, and in computers to employ one pushbutton for a number of operations. This usually takes place so that when a function key is pressed, the mode of operation of one, some or all of the pushbuttons change. The different modes of operation of each pushbutton are indicated close to the pushbutton, that is by providing symbols denoting the respective functions in each different mode of operation selectable by each action of the function key and which are distinguishable from each other by means of either their location, e.g. above, on, or below the pushbutton, or by the colour of the pushbutton. In addition, the on/off switch mode of the function key is indicated either with a separate symbol in the keyboard, as usual in calculators, or with a signal light in the pushbutton keyboard, indicating the active function key, as is common in computers. In addition, the pushbutton functions can be changed using the programming function of the device as, for instance, in word processing.

The essential feature in all such designs is that all conceivable pushbutton operations are simultaneously visible to the user. This gives rise to a problem that distinguishing the desired pushbutton operation is difficult and requires the user to pay additional attention either to the location of the indicating symbol or to the colour. Finding the desired pushbutton operation is particularly difficult in the dark, for example, with a radio telephone, when the keyboard is viewed with the aid of pushbutton illumination. Since the pushbutton illumination is relatively poor, locating one symbol among a great variety of symbols is difficult and distinguishing colour is questionable. Distinguishing the colours corresponding to the different modes of operation of the pushbutton of a mains-connected device, or of a device used in bright electrical light if there is not enough natural light, is not usually a problem because, in that case, sufficient general illumination is present or can be easily provided

because power consumption is not critical. However with portable devices used in darkness or in poor light without any external power source, sufficient general illumination cannot be provided because the power consumption would be too high.

According to the present invention there is provided an illuminated keyboard comprising one or more keys operable in at least two different modes having associated therewith means for indicating the respective different functions characterised in that, in each mode the respective indicating means associated with a mode is visibly distinguishable by a user when operating in that mode. This has the advantage that, at any one moment one is able to see, for each pushbutton, primarily only the symbol denoting the current function of each pushbutton. An advantage of the invention is also that the different functions of the pushbuttons are distinguishable in this manner when there are many functions for each key, even if the modes are selected sequentially by a function key.

Preferably, the associated indicating means comprises an illuminated region of the key, a separate region being illuminated for each selected mode. The internal illumination may be provided by a light emitting diode, which has the advantage of having low power consumption, which is ideal for portable devices.

Preferably, each separate region is coloured, the colour of which corresponds to the colour of the light transmittable by that region. This has the advantage that, the symbols denoting different functions are distinguishable also in general illumination when the internal illumination is not switched on.

The invention will be described, by way of example only, with reference to the accompanying drawings, of which:

Fig. 1 shows a schematic plan view of a pushbutton of a first embodiment of the invention;

Fig. 2 shows a schematic plan view of a pushbutton of a second embodiment of the invention;

Figs. 3a and 3b show the pushbutton of Fig. 1 in two different modes of operation;

Figs. 4a and 4b show the pushbutton of Fig. 2 in two different modes of operation;

Fig. 5 shows a cross-section of the pushbutton along the line X-X of Fig. 1 with a source of illumination;

Fig. 6 shows a cross-section of the pushbutton along the line Y-Y of Fig. 2 with a source of illumination; and

Fig. 7 shows a portable radio telephone incorporating a pushbutton keyboard of the invention.

The pushbutton keyboard 14 of a device, for example, a portable radio telephone, may comprise one or more internally illuminated pushbuttons 15 each pushbutton having symbols thereon designed to indicate the functions of the pushbutton 15 as illustrated in Figure 7. The pushbuttons 9,8 shown in Figures 1 and 2 operate in two pushbutton modes of operation

having a different function in each mode, whereby the first mode of operation is indicated by an alphabetic character "A" and the second mode of operation, indicated in the present case, by the numeric character "1". In the figures the alphabetic character is labelled 1 and the numeric character is labelled 2. In an array of several pushbuttons 15, the pushbutton 15 may, for example, together with the one presented include, analogically, all alphabetic characters in the first mode, for example, for keying in selected letters, and in the second mode all figures, for example, for keying in selected numbers and other potential additional symbols as shown in Fig. 7. The first mode of operation and the second mode of operation may include other functions in addition to the alphabet and the figures, for example operations required to use the device. The mode of operation is changed with the pushbutton 16(FCN).

In the first embodiment of Fig. 1 a pushbutton 9 comprises a translucent, coloured first area 5, the colour of which denotes the first mode of operation, having an opaque symbol "A" thereon indicative of the function of this pushbutton in this first mode. The other part of the pushbutton 9 comprises a second translucent coloured area 6 the colour of which denotes the second mode of operation, having an opaque symbol "1" thereon indicative of the function of this pushbutton in the second mode. The symbol "A" and the area 5 and the symbol "1" and the area 6 are positioned adjacent one another on the pushbutton 9. The pushbutton 9 contains internal pushbutton keyboard illumination, as shown in Fig. 5, provided by a light source 7, for example, a bicoloured LED (Light Emitting Diode). The light source 7 emits, selectively, light of a third colour or light of a fourth colour, as shown schematically in Fig. 5 by whole lines 3 and broken lines 4 respectively. This light source 7 is located below the underside 11 of the pushbutton 9, the pushbutton being viewed by the user from the outside 10. The two wavelengths of the light i.e. that of the third and fourth colours, and the materials of the pushbutton 9 are selected such that the wavelength absorption of the transparent areas 5 and 6 are such that the light of the third colour is transmitted through the first area 5, but not the second area 6, while the light of the fourth colour is transmitted through the second area 6, but not the first area 5. It goes without saying that this light source 7 emits both colours over the surface of the entire pushbutton independent of the colour. When the pushbutton 9 and at the same time its light source 7 have been coupled either using a function key 16 (in the instance of a radio telephone) or, as a result of the logical operation of the pushbutton keyboard, so as to select the second pushbutton mode of operation, the light source 7 emits the light of the fourth colour, which is transmitted through the second area 6 but not the first area 5. As a result the operator sees the first area 5 black or at least very dark and the second area 6 il-

luminated relatively brightly. In this case the symbol "A" on the area 5 cannot be distinguished, whereas in the area 6 the symbol "1" can be seen clearly. The symbol "1" is the one which corresponds to the second pushbutton function presently in operation, and this is illustrated in Fig. 3a. If, instead, the pushbutton 9 and, at the same time, the light source 7 are coupled so to select the first pushbutton mode of operation, the light source 7 emits the light of the third colour which is transmitted through the first area 5, but not the second area 6, whereby the first area 5 appears to the user as being relatively brightly illuminated and the second area 6 black or dark. In this case, the symbol "A" corresponding to the first pushbutton function can be distinguishable in the first area 5, whereas no symbol is visible in the second area 6 as illustrated in Fig. 3b.

Figs. 2, 4a and 4b, and 6 illustrate a second embodiment of the pushbutton according to the invention, its design being the reverse to the one described above. In this case, the pushbutton 8 comprises a mainly opaque material 12 having a first translucent symbol 1 thereon indicative of the pushbutton function when in a first mode of operation, the translucent symbol 1 being made of a first material having a colour denoting the first pushbutton operation, and a second translucent symbol 2 thereon indicative of the pushbutton function when in a second mode of operation, the second translucent symbol 2 being made of a second material having a colour denoting the second pushbutton operation. The symbols 1,2, which in the present case are similarly represented by the characters "A" and "1" as in Fig. 1, have in each case been placed on the pushbutton 8 relative to one another, as illustrated in Figure 2. The pushbutton 8 also comprises a light source 7 emitting, selectively, light of a third colour and light of a fourth colour, as shown schematically in Fig. 6 by dotted lines 3 and whole lines 4 respectively.

As with the first embodiment, the two wavelengths of the emitted light and the materials of the translucent symbols are selected such the wavelength absorption of the translucent areas are such that light of the third colour is transmitted through the first symbol 1, but not the second symbol 2, while light of the fourth colour is transmitted through the second symbol 2 but not the first symbol 1.

Thus, when the light source 7 has been selected to operate in the second pushbutton mode of operation, it emits light of the fourth colour towards the underside 11 of the entire pushbutton 8, whereby the emitted light is transmitted through the second symbol 2 but not the first symbol 1. As a result, the operator sees the pushbutton as in Fig. 4a, i.e. the number "1" is clearly lit while the rest of the pushbutton 8 looks black or dark. If instead, the light source 7 is selected to operate in the first mode of operation, it emits light of the third colour, which is transmitted through the

first symbol but not the second symbol 2, such that the user viewing from the outside 10, sees the letter "A" clearly lit, whereas the rest of the pushbutton is black or dark.

Thus, only the symbol relating to the selected mode of operation is visible for each pushbutton, and the symbols relating to other modes of operation cannot be seen by the operator until the pushbuttons are switched to those other modes. When the mode of operation of the pushbuttons is changed, e.g. using the function key 16, the function key 16 may be illuminated as described above, i.e. by a function symbol denoting a first mode of operation, and a function symbol denoting a second mode of operation, equally as described above. The function key 16 is similarly provided with a light source 7 as described above. The difference from the embodiment described above is that the power is maintained in the light source 7 of the function key so that it emits simultaneously both the light of the third colour and the light of the fourth colour, such that both symbols are visible in different colours at the same time. This assists in observing the function key. Another alternative would be to illuminate the symbol denoting of the mode of operation which is not in use or which will be next in succession. This indicates clearly the change in the mode of operation to be implemented by the subsequent use of the function key. It is also possible to use a function key provided only with one symbol and one colour, as in the pushbutton keyboard 14 of the radio telephone of Fig. 7 because the function keys demonstrate, in themselves, the mode of operation.

The above mentioned bicoloured light emitting diode 7 can be substituted by two photodiodes each emitting a different colour, or by two electroluminescence elements (EL element) each emitting a different colour, these being placed side by side at a suitable point or at a distance which is equivalent to the distance, L, of the symbols from each other, as shown in Fig. 1. The colours emitted selectively by the two photodiodes or by the electroluminescence elements are the third and fourth colours. Alternatively, the lighting for the entire pushbutton keyboard may be arranged by means of a bicoloured photodiode or two single-colour photodiodes common thereto, and by providing the pushbutton keyboard with light guides, such as optical fibres, which transport the emitted light to each pushbutton. It is also conceivable that some of the pushbuttons may be illuminated by means of a common photodiode and common light guides, while one or some of the pushbuttons by photodiodes of their own in order to denote the modes of operation independently of one another. When two different photodiodes are used in each pushbutton or when light is derived from two different common photodiodes, the light beams can to some extent be focussed to the area in which the light is supposed to transmit because of its colour.

The pushbuttons may denote a greater number of modes of operation than the two mentioned above, for instance three modes. In that case, the surface of the pushbutton has a third area, having a symbol thereon indicative of the function of the pushbutton in this mode of operation, and made either of a translucent material of a different colour or an opaque symbol located in the area made from this material, as described above. A second or a third photodiode is used for emitting light of another colour, which cannot be transmitted through the earlier described areas, but may be transmitted through the area of the different colour, but which on the other hand is not capable of transmitting the lights of the third or the fourth colour.

A light source other than a photodiode or photodiodes can be used, for example electroluminescent elements of similar type as those used for background light. In principle, filament lamps may also be used for illumination by employing appropriate filters, before the lamps or a photoconductor, of, for example colours denoting the modes of operation. Also other light sources, such as semiconductor lasers, are conceivable. However, the LEDs and EL elements mentioned at the beginning are advantageous owing to their low power consumption. With these, sufficiently limited emission bands in a clearly visible wavelength area can be provided so as to produce the emphasis of the invention when using filters of approximately the same transmission bands in coloured areas.

Translucent, as used in this specification, includes transparent, and the terms are used interchangeably.

The transparent coloured parts may be made of a bright or diffusive transparent material such as plastic or laminates made therefrom, and so on. In particular, if the coloured parts are made such that the underside 11 facing the light source 7 is made of a light transmitting but diffusing non-colouring material which in the reflective light looks white, and upon which is placed a film of bright colour, or such that it is made of a coloured diffusing material which transmits and diffuses light, the symbol appears without any internal illumination to have colour in external lighting. In this situation the pushbutton keyboard looks the same as any pushbutton keyboard provided with symbols distinguishable by colour.

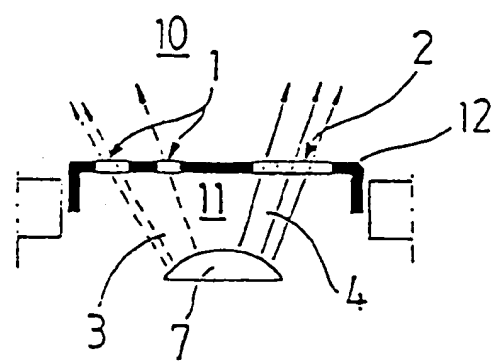
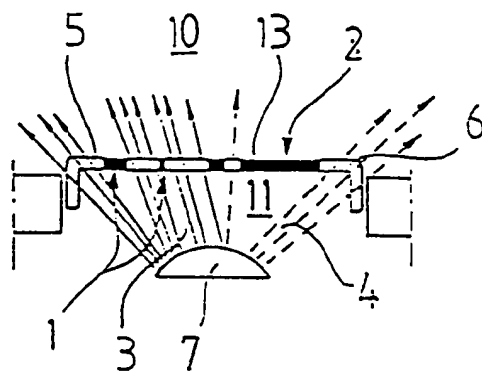
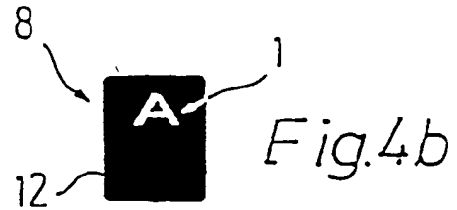
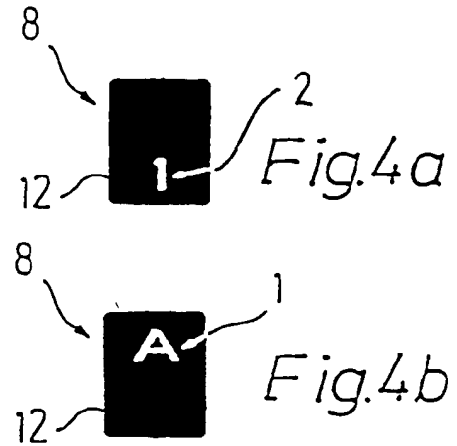
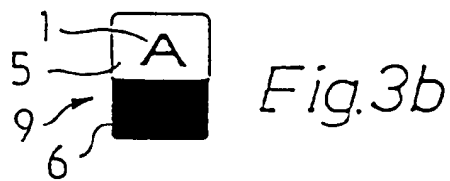
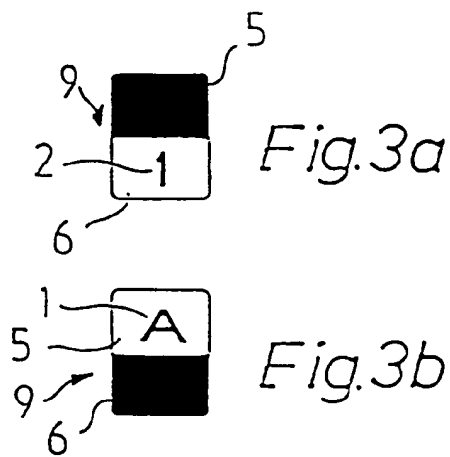
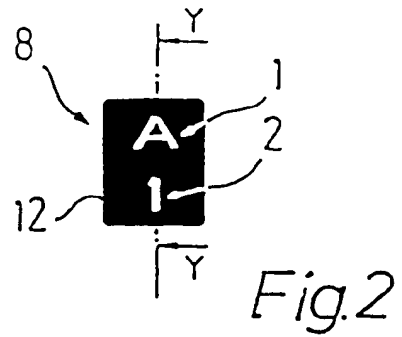
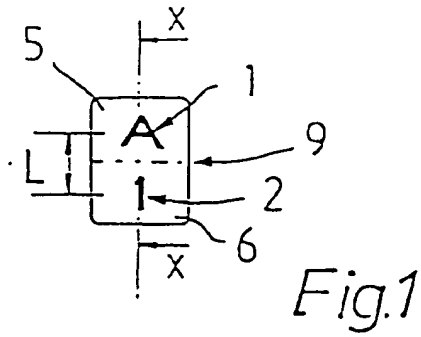
The symbols may be shaped on the pushbuttons in any manner known themselves in the art if the above described properties are formed.

One more opportunity is to use reflective colours on a non-transparent base for the symbols. For example, bicoloured illumination may be provided as described above, but focussed from the top onto the symbols, in which one wavelength of the light is reflected from the symbols indicative of one mode of operation, but is absorbed by symbols indicative of the other modes of operation, the same effect is created both in the internal illumination and external illumina-

tion as described above.

### Claims

1. An illuminated keyboard comprising one or more keys (8,9) operable in at least two different modes, and having associated therewith means (1,2,5,6) for indicating the respective different modes characterised in that, in each mode the respective indicating means associated with a mode is differentially visibly distinguishable by a user, when operating in that mode.
2. A keyboard according to Claim 1, characterised in that the associated indicating means comprises an illuminated region of the key, a separate region being illuminated for each mode.
3. A keyboard according to Claim 2 characterised in that the keys are internally illuminated by a light source (7) operable to emit light at different wavelengths, each different wavelength being associated with a different mode, the keys being formed such that each separate region transmits only light of that wavelength associated with the mode with which that region is associated.
4. A keyboard according to Claim 3 characterised in that the light source is located internally of each key.
5. A keyboard according to Claim 3 characterised in that the light source is located remote from the keyboard, the light being conducted to the interior of the keys by a light guide.
6. A keyboard according to any of claims 3 to 5 characterised in that then light source is a single light source operable to emit light at the different wavelengths.
7. A keyboard according to any of claims 3 to 5 characterised in that the light source comprises a plurality of individual light sources, each operable to emit light of a single wavelength, each wavelength being different.
8. A keyboard according to any of the claims 3 to 7 characterised in that the light source is operable to selectively emit the light of different wavelengths.
9. A keyboard according to any of claims 3 to 7 characterised in that the light source is operable to emit the light at the different wavelengths simultaneously.
10. A keyboard according to any of claims 3 to 9 characterised in that the light source comprises a light emitting diode.
11. A keyboard according to any of claims 2 to 10 characterised in that each separate region carries an opaque symbol indicating the mode with which that region is associated.
12. A keyboard according to any of the Claims 2 to 10 characterised in that each separate region is in the shape of a symbol indicating the mode with which that region is associated.
13. A keyboard according to any of Claims 2 to 12 characterised in that each separate region is coloured, the colour of which corresponds to the colour of the light transmittable by that region.
14. An internally illuminated pushbutton keyboard, comprising an individual pushbutton or an array of several pushbuttons in which each function key (8,9) may operate in order to produce at least two different modes of operation while pressing said key and in which said alternative pushbutton operations are marked on the pushbutton or adjacent thereto, distinguished from one another at least with a colour and by selecting with a separate function (16), or as a result of the logical operation of the means comprising the pushbutton keyboard, whereby the mode of operation of the key of the entire pushbutton array, changes each time into another, characterised in that the colour of the pushbutton keyboard illumination (7) has been arranged to change in conjunction with a change of the pushbutton operation so that the colour of the illumination each time, at least approximately, corresponds to the symbol colour of the operative pushbutton operation for illuminating it and, at the same time, for keeping the symbol colour of the modes of operation not in use, and as a result, for keeping the respective symbol invisible or at least poorly visible.





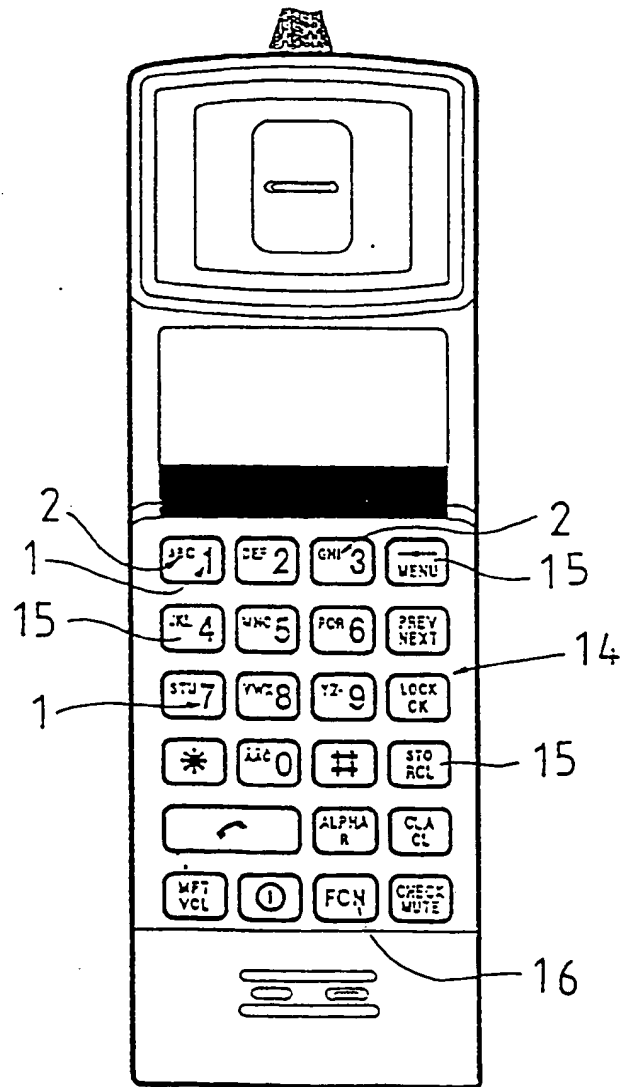


Fig. 7



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# EUROPEAN SEARCH REPORT

Application Number

EP 92 30 0693

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. CL5)
X A	DE-A-3 235 752 (SIEMENS A.G.) * page 2, line 5 - page 3, line 32; claim 1; figure 1 *	1,14 3,4,6,8, 10	H04M1/22
X A	US-A-4 454 501 (BUTTS) * column 2, line 26 - line 38; claims 1-3,7,9; figure 2 *	1,14 2,4,10, 11	
X A	DE-A-3 825 895 (SIEMENS A.G.) * column 1, line 1 - line 20; claims 1,2; figure 1 * * column 1, line 61 - column 2, line 21 * * column 3, line 11 - line 14 *	1,14 10	
X A	EP-A-0 024 620 (SIEMENS A.G.) * page 1, line 10 - line 14; claim 1; figure 1 *	1,14	
A	US-A-4 489 310 (TROSTYANETSKY) * column 1, line 5 - column 2, line 43; claims 1,5,8,9,11; figure 4 * * column 7, line 22 - line 62 *	1,14	TECHNICAL FIELDS SEARCHED (Int. CL5)  H04M H03H
A	DE-A-3 416 828 (TELEFONBAU UND NORMALZEIT G.M.B.H.) * page 3, line 1 - page 4, line 3; claim 1 *	1,14	
A	DE-A-3 139 501 (SIEMENS A.G.) * column 1, line 59 - column 2, line 36; claim 1 *	1	
A	EP-A-0 279 233 (SIEMENS A.G.) * column 1, line 1 - column 4, line 2; claim 1; figure 1 *	1	
A	GB-A-2 154 393 (STANDARD TELEPHONES AND CABLES PLC) * page 1, line 5 - line 27; claim 1; figure 1 *	1	
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 12 AUGUST 1992	Examiner DE HAAN A. J.
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons A : member of the same patent family, corresponding document			

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